REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)* 16-05-2006	**2. REPORT TYPE** FINAL	**3. DATES COVERED** *(From - To)*
4. TITLE AND SUBTITLE Space OPCON: Who's Watching Zeus?		**5a. CONTRACT NUMBER**
		5b. GRANT NUMBER
		5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S) Lieutenant Colonel Todd Zachary, USAF Paper Advisor (if Any): Lieutenant Colonel Derrill Goldizen, USAF		**5d. PROJECT NUMBER**
		5e. TASK NUMBER
		5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Joint Military Operations Department Naval War College 686 Cushing Road Newport, RI 02841-1207		**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		**10. SPONSOR/MONITOR'S ACRONYM(S)**
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Distribution Statement A: Approved for public release; Distribution is unlimited.

13. SUPPLEMENTARY NOTES A paper submitted to the faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.

14. ABSTRACT
Over the past decades operations from and through space have given U.S. forces tremendous advantages on the battlefield. However, the high demand for space resources has always outstripped the available capacity, inevitably leading to a debate in regard to the command and control of space operations. Given the nature of the space environment, current space doctrinal roles and missions, and the capabilities space systems bring to the battlespace this paper contends that command and control of space operations needs to remain within U.S Strategic Command rather than in an operational theater. In examining this thesis, the paper defines the considerations that operational planners must take into account when conducting operations in and through space. It explains the composition and nature of current command organizations and relationships in the execution of space operations. It explores current and near-term space capabilities and its impact on joint space command and control doctrine. Finally, the paper draws conclusions concerning the most effective space command structure and recommends areas for further research and analysis in the continued evolution of joint space doctrine

15. SUBJECT TERMS
Space Operational Command and Control

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON** Chairman, JMO Dept
a. REPORT UNCLASSIFIED	**b. ABSTRACT** UNCLASSIFIED	**c. THIS PAGE** UNCLASSIFIED		32	**19b. TELEPHONE NUMBER** *(include area code)* 401-841-3556

Standard Form 298 (Rev. 8-98)

NAVAL WAR COLLEGE
Newport, R.I.

Space OPCON: Who's Watching Zeus?

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

Signature: __________________________

16 May 2006

Abstract

Space Operational Control: Who's Watching Zeus

Over the past decades operations from and through space have given U.S. forces tremendous advantages on the battlefield. However, the high demand for space resources has always outstripped the available capacity, inevitably leading to a debate in regard to the command and control of space operations. Given the nature of the space environment, current space doctrinal roles and missions, and the capabilities space systems bring to the battlespace this paper contends that command and control of space operations needs to remain within U.S Strategic Command rather than in an operational theater. In examining this thesis, the paper defines the considerations that operational planners must take into account when conducting operations in and through space. It explains the composition and nature of current command organizations and relationships in the execution of space operations. It explores current and near-term space capabilities and its impact on joint space command and control doctrine. Finally, the paper draws conclusions concerning the most effective space command structure and recommends areas for further research and analysis in the continued evolution of joint space doctrine.

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In Greek mythology the god Zeus ruled over Mount Olympus throwing lightning bolts from the heavens to smite those who displeased him. While lightning is confined to a weather phenomenon, the ability of space assets to directly or indirectly affect a battlespace anywhere on the planet is a reality. For all its capabilities however, few within the Department of Defense (DoD) have a clear understanding of space's potential and limitations. Certainly one of the least understood aspects of space operations is command and control (C^2). In the fight for extremely limited space assets a persistent doctrinal battle has been raging as to who should retain operational control of space capabilities: the theater commander or a centralized agency such as US Strategic Command (USSTRATCOM).

The purpose of this brief paper is twofold: first to demonstrate why control of U.S. military space resources given the operating environment, space roles and missions and the capabilities space brings to the battlespace needs to be retained within USSTRATCOM rather than delegated to an operational theater commander. In accomplishing this we will explore the environmental considerations of operating in space, current doctrine in regard to space missions and command organization and lastly current and near-future space capabilities. A secondary purpose is to increase understanding in regards to space that is desperately needed across DoD if its personnel are to effectively employ this truly American asymmetric advantage.

The Reality of Space

Space is a unique environment beset with operational challenges resulting from the principles that govern the medium. While this may seem to be simply stating the obvious, it is necessary to examine the space environment given that the terms used to describe force characteristics or attributes actually summarize the military experience that stands behind doctrine.[1] For example, the characteristics of air forces – range, speed and maneuverability – summarize the experience that dictates an air power doctrine distinct from land or sea doctrines.[2] It is not the intention of this section to teach orbital mechanics, but instead to simply sketch the "terrain" in which space assets operate. Given the desire to keep things simple, we will examine space characteristics through two lenses: environmentally influenced and systems influenced characteristics.

Environmentally Influenced Characteristics

Terrestrial forces, with the exception of naval submarines, operate within the Earth's atmosphere, which dictates the way things move, weapon effects and the interplay of man in the control loop. Space, bound by a vastly different environment, imposes a different set of rules. The first rule is that space systems have almost instantaneous global presence, in that their high vantage point and speed, relative to the earth's surface, means their area of coverage is exceptionally large, spanning far beyond traditional theater-level boundaries.

Secondly, while high speed enables significant capability in terms of coverage, the substantial orbital angular momentum it implies does limit vehicular maneuverability and positioning, especially given the limited fuel capacity inherent within most systems and the congested nature of space orbits.[3] Hence, for all practical purposes, space vehicles can best

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[1] David E. Lupton, On Space Warfare: A Space Power Doctrine (Maxwell AFB, Ala: Air University Press 1988), 17.

[2] Ibid.

[3] Included at Appendix 1 is a 2003 report on the number of space objects in orbit to illustrate the congested nature of the orbital environment. USSPACECOM daily tracks and monitors to its maximum extent possible all objects in orbit providing information to a wide variety of governmental agencies (both US and foreign) and civilian companies. Space situational awareness is absolutely critical to orbital deconfliction on a global scale prior to any space vehicular launch, deployment and operational movement.

be described as quasi-positional forces that require significant monitoring and maintenance to ensure orbital integrity is maintained.[4]

Lastly, weapon effects are vastly different in space. Theoretically space-to-space weapons designed to impede or destroy other systems will need to weigh the intended effect against the entire orbital environment. Without atmospheric or terrain constraints, weapon ranges are relatively unlimited, and after-effects could remain within earth orbit for a significant period of time, potentially threatening both friendly and neutral space systems.[5] For example, the destruction of a satellite could have an unintended effect of generating radiation or debris fallout that would remain in orbit thereby threatening the orbital integrity of every other system within the same orbit pattern. This argues for an organizational command structure with world-wide situational awareness beyond traditional theater command capabilities.

Systems Influenced Characteristics

Space systems (comprising the vehicle itself and the support and control mechanisms) differ significantly from terrestrially based systems, given the unforgiving and demanding nature of the operational environment. Operating a vehicle in space requires significant investment in planning to address myriad issues from system interoperability to orbit mechanics to lifecycle cost analysis before the system even leaves the drawing board.

Of chief concern is the logistical and resource requirement of the system itself. Placing a vehicle or satellite in space is exorbitantly expensive. Most satellites weigh between two to ten thousand pounds at a cost roughly $4000-6000 per pound to launch; this means that the total cost of putting a medium sized satellite into orbit is roughly $100

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[4] David E. Lupton, On Space Warfare: A Space Power Doctrine (Maxwell AFB, Ala: Air University Press 1988), 20.
[5] Ibid, 22

million.[6] While this may appear similar in terms of cost to other high-tech weapon systems like the B-2 bomber, satellites given their inherent inaccessibility have to work perfectly the first time with enough technical flexibility built in if it is to be able to adapt to new control mechanisms or mission tasking.

The tremendous complexity required in merging high technical capability with enough flexibility to ensure that a satellite can adapt throughout its lifecycle demands a singular agency for developmental vision, employment and maintenance. While sharing similarities in terms of high cost, advanced aircraft like the B-2 bomber are far more flexible, able to literally change missions, even in an austere theater environment, with a simple change in payload or an in-flight decision by its aircrew. This flexibility grants an aircraft a wide degree of autonomy to meet a theater commander's changing operational need. Space systems, given their extensive global infrastructure support and the sheer rigidity of orbital mechanics, cannot be as responsive.

Space-generated effects must rely on organizational, not system, flexibility inherent within a streamlined central agency capable of tapping into a wide range of systems, both military and civilian, to meet the needs of a theater commander. While it is certainly possible to place space systems under the direct control of a theater commander the question that must be asked from a strictly technical support position is whether this would enhance space system response efficiency. The answer is no, as it would require either a large logistics and support footprint in theater to duplicate the capability already inherent within USSTRATCOM, or the acceptance of a potential bureaucratic delay inherent within a reach-

[6] Michael E. O'Hanlon, Neither Star Wars Nor Sanctuary: Constraining the Military Use of Space (Washington DC: Brookings Institute Press, 2004), 34. Additional Note: Large satellites like the current U.S. imagery systems typically run upwards of $400 million to place into orbit.

back organizational construct when attempting to augment space capability through the use of non DoD systems and organizations not located within theater – both undesirable.

Schools of Thought to DoD Space Missions

In his 1988 work entitled *On Space Warfare: A Space Power Doctrine,* author David E. Lupton provides a comprehensive working model that examines four fundamental theories surrounding the utility and militarization of space. This may prompt the reader to ask why explore space theory; shouldn't the focus be on current doctrine? The difficulty is that current space doctrine, whether written at the joint, service specific or interagency level is in many areas highly ambiguous, seeking to define principles for a field that is evolving daily in technical application. As a result, space doctrine has evolved more from conceptual theory than from historical evidence thereby an understanding of Lupton's four schools of space power theory as a precursor to doctrine development *will help to frame current space doctrinal tenets and explore the seams where friction arises between the various services and interagency organizations that employ space assets*.

The *Sanctuary School* theory views space as a medium through which the free passage of surveillance systems grants a tremendous stabilizing influence on state-to-state relations. Proponents argue that space overflight, irrespective of traditional national boundaries, is vital to the maintenance and verification of existing and future international treaties. Overflight is granted to any nation with the capability because no nation has actively sought to deny or control the use of space. Advocates conclude that the only way to maintain the legal overflight characteristic is to designate space as a war-free sanctuary.[7] This view is increasingly prevalent in the growing commercial space sector for obvious reasons –

[7] David E. Lupton, On Space Warfare: A Space Power Doctrine (Maxwell AFB, Ala: Air University Press 1988), 35.

unimpeded space access enhances the potential to reach a greater business market. Military commanders must be cognizant of this potentially divergent perspective when crafting an operational plan that attempts to control or regulate space activities while at the same time relying on commercial satellite services to augment DoD capability. A singular DoD agency that has established a strong working relationship with the civilian sector would have distinct advantages in assuring civil concerns are addressed in any space control scenario.

Survivability School proponents concede that space does have some military applicability, specifically as a enabling or enhancement tool of terrestrial forces, but contend that the relative fragility of space systems renders them exceptionally vulnerable in times of war.[8] Advocates of this idea view an ever-increasing US reliability on space as simply providing a potential enemy a lucrative and exploitable target through which to strike against American security and economic interests. Hence, America should not invest too heavily or exclusively in space systems as their survivability in war is suspect. A significant concern, this belief is common within wide circles of DoD, serving as a rallying call to develop acquisition and employment strategies to compensate or reduce space system vulnerabilities.

The *Control School* declines to place an exact value on space forces and only suggests their value by using air and sea power analogies.[9] Arguing that there are space lines of communication akin to traditional sea and air lanes, control advocates argue that the capability to deter war is enhanced by the ability to control space, and that in future wars, space control will be coequal with air and sea control.[10] This view is gaining significant ground within DoD, underpinning its new Operationally Responsive Space (ORS) initiative discussed in later sections.

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[8] Ibid, 36.
[9] Ibid, 36.
[10] Ibid, 37.

The *High Ground School* harks back to the old military axiom that domination of the high ground ensures domination of the battlefield. Proponents argue that the global presence of space, combined with directed energy or kinetic weapons, provides opportunities for radical new national strategies.[11] High ground advocates favor full weaponization of space with space control being an essential prerequisite. From a DoD perspective, given the recent 2006 Quadrennial Defense Report (QDR), this appears to be the long-range road ahead and offers the greatest potential for, and argument in favor of, theater control of space based assets.

Almost all of the concepts embodied within Lupton's model have been reflected in actual space programs and strategies that received differing levels of national-level support at various times throughout the space age.[12] The first U.S. strategy, shaped by the limitations of space technology at the time, was highly secret and championed the *Sanctuary* approach in supporting the free over-flight of spy satellites so critical to gathering vital intelligence on the Soviet Union. As space technologies continued to evolve, however, more ambitious strategies and potential applications began to be explored. Thus, akin to early airpower theories during the 1920-1940s, space strategies have almost always preceded actual capability.

With roots and beliefs embedded within Lupton's model, current DoD strategy outlines the roles and functions of space systems as serving one of four distinct missions:

- *Space Support* is an exceptionally broad mission that contains all "operations that launch, deploy, augment, maintain, sustain, replenish, deorbit, and recover space forces,

[11] Ibid, 37.
[12] Peter Hays and others, Spacepower for a New Millennium (New York: McGraw-Hill, 2000), 6.

including the command and control network configuration for space operations."[13] This mission also includes all the personnel, education and training systems required to sustain military space activities.

- *Force Enhancement* is the primary emphasis of current U.S. space forces in an effort to "…multiply joint force effectiveness by enhancing battlespace awareness and providing needed warfighter support."[14] As the predominant emphasis, U.S. doctrine further divides the *force enhancement* mission into five distinct functions: Intelligence, Surveillance and Reconnaissance (ISR); integrated tactical warning and attack assessment; environmental monitoring; communications; and position, velocity, time, and navigation.[15] However, unlike other space missions, DoD recognizes that these functions are often provided by non-DoD agencies such as the National Aeronautics and Space Administration (NASA). While myriad governmental agencies focused upon this mission strive to work together to the warfighter's benefit, like all large, entrenched organizations, they do have their separate institutional biases and beliefs. While there is widespread consensus among the various agencies that the *force enhancement* mission certainly is one that the U.S. should perform, there is a strong debate on the placement of weapons in space.[16] While this debate is beyond the scope of this paper, the outcome does have potential ramifications for interagency cooperation and the organizational structure of U.S. military space forces, as the field demands a single agency to champion for and coordinate DoD space activities.

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[13] Joint Chiefs of Staff, Joint Doctrine for Space Operations, Joint Pub 3-14 (Washington DC: 9 August 2002), IV-10
[14] Ibid, IV-8
[15] Ibid, IV-8
[16] Peter Hays and others, Spacepower for a New Millennium (New York: McGraw-Hill, 2000), 5.

- *Space Control* operations "…provide freedom of action in space for friendly forces while, when directed, denying it to an adversary, and include the broad aspect of protection of U.S. and allied space systems and negation of adversary space systems."[17] Space control strives to counter the growing vulnerability of space assets through the employment of both offensive and defensive capabilities designed to shape and control the space environment. However, while systems are still being developed, a basic tenet must first be addressed. A fundamental precursor to space control is near, if not complete, space awareness, simply defined as the ability to track and identify every object in earth's orbit. While this presents significant technological challenges, the most difficult barrier may in fact be interagency coordination. Despite a variety of government agencies in the space arena, DoD through the lead of its designated Executive Agent, the U.S. Air Force (USAF), has made significant headway in bridging the interagency coordination gap.
- The fourth and least doctrinally espoused is *Force Application.* In fact, the only mention of this mission in joint doctrine is:

  > "The application of force would consist of attacks against terrestrial-based targets carried out by military weapons systems operating in or through space. The force application mission area includes ballistic missile defense and force projection. Currently, there are no force application assets operating in space."[18]

  While there are indeed no current conventional force application systems operating in or through space, the 2006 QDR certainly directs the U.S. military to develop the capability within the next decade.[19] Given the high cost of space systems, fiscal prudence demands

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[17] Joint Chiefs of Staff, Joint Doctrine for Space Operations, Joint Pub 3-14 (Washington DC: 9 August 2002), IV-5.

[18] Ibid, IV-10. Some may argue that the U.S. has had a force application from space capability since the development of the first nuclear Inter Continental Ballistic Missile (ICBM). While this may be technically true, the reluctance to use these weapons given the potential ramifications resulted in little to no direct influence in combat force application. Force application is by conception based on conventional weapon employment.

[19] Department of Defense, Quadrennial Defense Review, (Washington DC, 6 January 2006) 46-50. Specifically, the QDR tasks the U.S. military to 1) Develop a new land-based, penetrating long range strike capability to be fielded by 2018 while modernizing the current bomber force and 2) Within two years, deploy an initial

the appointment of a centralized agency, in this case USSTRATCOM, to make the difficult budgetary and developmental decisions; however, little to no doctrinal work has been done on how these systems, once fielded, will support the joint warfighter.

Interim Conclusions

As a quick review: operating in space is not simply applying air power concepts at greater altitude. Space has unique and significant environmental factors and challenges that instantaneously force operations to adopt a global scale. Given the symbiotic relationship amongst comparatively fragile space systems, any operations to and through space must consider the impact of the action upon the entire space architecture, whether military or civilian. The resource requirement in terms of personnel, equipment and interagency cooperation to support space operations is immense and on such a scale as to advocate for a central command and control structure.

U.S. governmental policy towards space is currently fragmented and is dependent on the federal agency involved, but generally tends to adopt one of four schools of thought in regard to the use of space. DoD doctrine outlines four missions for space, and while primarily focused on *force enhancement*, it is looking to expand its role in regards to *space control* and *force application*, albeit both missions are significantly lacking in doctrinal and resource development.

Current Space Organizational Relationship

Joint Publication 3-14 *Joint Publication for Space Operations* and Air Force Doctrine series 2.2 *Space Operations* outline DoD's command and control (C^2) structure for space.

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capability to deliver precision-guided conventional warheads using long-range Trident Submarine-Launched Ballistic Missiles. Clearly both such systems would provide a significant space force application capability.

Doctrinally there are four basic forms of command relationships: combatant command (COCOM), operational control (OPCON), tactical control (TACON), and support.[20] The Secretary of Defense (SecDef) assigns forces under the COCOM of an appropriate combatant commander, but may temporarily transfer or attach these same forces to a secondary combatant commander by granting him/her OPCON until the need or requirement has passed. In regards to space, USSTRATCOM has overall COCOM of DoD resources and operations and in turn has delegated OPCON to Air Force Space Command (AFSPC), who executes daily operations through 14th Air Force (14 AF).

At SecDef's direction, USSTRATCOM will transfer space forces to another combatant commander or theater Joint Force Commander (JFC). The JFC in turn generally delegates this OPCON authority to the appropriate Service component commander, usually the Commander Air Force Forces (COMAFFOR), who is typically "dual-hatted" as the Joint Force Air Component Commander (JFACC).[21] An example would be the transfer of a joint tactical ground station detachment to an operational theater command to enable a reach-back capability to a nationally controlled USSTRATCOM space asset such as an ISR satellite or a theater ballistic missile warning system.

[20] Chief of Staff, United States Air Force, Counter Space Operations. Air Force Doctrine Document 2-2.1. (Washington DC: 2 August 2004), 7. Doctrinal definitions of COCOM, OPCON and TACON can be found at appendix 6.
[21] Chief of Staff, United States Air Force, Counter Space Operations. Air Force Doctrine Document 2-2.1. (Washington DC: 2 August 2004), 9.

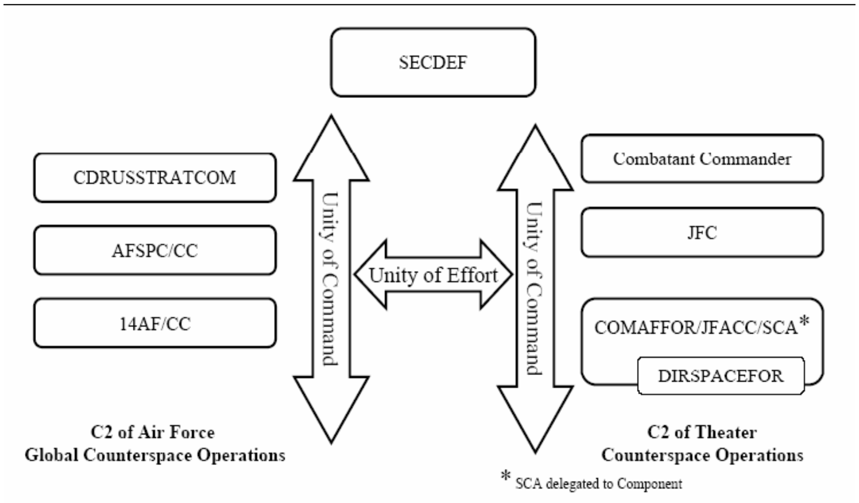

Figure 1. Notional Overview of Space Roles and Responsibilities[22]

USSTRATCOM translates global and theater space requirements into a coherent, executable plan via the Space Tasking Order (STO) cycle. Conducted by 14 AF's AOC (Air and Space Operations Center), the STO, vetted with the theater air campaign plan, provides daily tactical tasking for AF global space forces.[23] However unlike a theater Air Tasking Order (ATO) that directs activities within its specific theater, a STO directs space operations across the entire globe.[24] The STO supports ongoing requirements such as Global Positioning System (GPS) navigation and missile warning for the North American Aerospace Defense Command, as well as theater contingencies like Operation IRAQI FREEDOM.[25] Given the global nature of space, the STO must both deconflict multiple-theater space requirements and integrate global space effects into theater operations.[26]

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[22] Ibid, 10.
[23] "Doctrine Watch #21: Space Tasking Order." U.S. Air Force Doctrine Publications. 12 March 2004. https://www.doctrine.af.mil/Main.asp> 28 April 2006. 1.
[24] Ibid
[25] Ibid
[26] Ibid

STO support to a given theater occurs when 14 AF's AOC, with guidance from the in-theater JFACC, develops space courses of action in support of theater campaign plans and/or operations.[27] While similar to a theater level ATO in regards to outlining operations, the STO is unique given the global nature of space missions. Much as the ATO orchestrates an integrated theater air, space, and information operations effort, the STO optimizes global space operations by balancing high-demand low-density space assets against global and theater requirements.[28] Examples of current STO mission taskings may include: optimizing GPS for theater precision air strikes or focusing warning systems on a particular theater to alert deployed troops to missile attacks.[29]

This command relationship (OPCON of selected reach-back assets) grants a theater JFC tremendous space-based capability without the logistical and manpower requirement necessary to maintain global space operations. This is not to suggest, however, that friction between competing theater and global requirements does not occur, especially given the high demand for and low density of space resources. However, this point of friction has recently lead some to argue that greater theater OPCON of space assets will allow a JFC to better execute his/her theater campaign plan by providing direct control over all space operational resources.

The problem with this argument is that STOs *by their very nature* must be globally focused and consider primary and secondary impacts–not only upon military operations, but on the entire space support environment. For example, suppose that a theater JFC has been granted OPCON over counter-space assets and is faced with an enemy with a significant reliance on GPS. The JFC, focused on degrading adversarial capability in theater,

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[27] Ibid.
[28] Ibid
[29] Ibid, 2.

downgrades the accuracy of GPS though an advanced signal encryption. However, given GPS's global reach, the theater JFC's actions create an unintended secondary effect in degrading other combatant commands, allied nations, space constellations that use GPS for orbital maintenance, let alone generating a significant civil economic impact. Should the theater JFC be tasked then with the responsibility to account for his space operational effects on a global scale thereby siphoning invaluable resources and time away from vital theater planning? The current STO command organizational structure relieves the JFC of this unneeded global responsibility while providing exceptional space support to the operational warfighter.

Future Paradigm Shift in Space Operations

At this stage in our discussion we have explored the effect of the space environment, roles and missions of space forces and command relationships to help define the nature and requirements of space C^2. In this next section, we will briefly touch on the scope and scale of current and near-term future space systems and architectures to demonstrate the continued necessity, especially given their reach and symbiotic global impact, of keeping space C^2 within a centralized framework. As such, it is not necessary to identify each space system or to delve into the technical specifics, but instead to examine space capabilities both as they currently exist and in the near future.[30]

Current U.S. space capabilities on a macro scale are highly concentrated in the *force enhancement* regime with limited capability remaining to support space operations in terms of launch vehicles. To meet the growing space force enhancement needs of its military, the U.S. has invested in a series of satellite constellations to provide ballistic missile warning, communications, weather and navigation information around the globe. USSTRATCOM as

[30] For the more curious, a listing of current major U.S. space systems is contained within Appendix 4.

the principal space command element coordinates the growing use of commercial communications satellites, civil weather satellites and civil and foreign multi-spectral imagery satellites to augment the high demand for military space systems.[31] As DoD's executive agent, the Air Force spends approximately $3 billion a year on providing these services and allocates approximately an additional $3 billion to modernization and replacement initiatives.[32] Major near-term space acquisitions are continuing to focus largely on force enhancement, with significant investments being made in advanced communication satellites, missile warning systems incorporating advances in space-based infrared capabilities and a series of upgrades to GPS.

Beyond the modernization of existing U.S. space systems however, there is a strong feeling within the space community that we are on the brink of a paradigm shift in the future architecture of space. In the past, activities in space were dominated by U.S. governmental agencies such as DoD and the National Aeronautics and Space Administration for either military support or exploration.[33] However, since 1997 there has been an explosive expansion in the private space sector, not only in terms of the number of satellites in orbit, but also in adaptive follow-on civilian applications that exploit existing space systems.[34] A perfect example is GPS, a DoD managed program that, while enhancing U.S. forces, now has tremendous economic impact within the private sector. Space has become in essence an invaluable commodity in modern life.

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[31] "STRATCOM Fact Sheet." Center for Space Studies. March 2004. < http://space.au.af.mil/index.htm> [15 April 2006].
[32] "Space Systems Budget Allocation." United States Air Force: Committee Staff Procurement Backup Book, FY 2006/2007 Budget Estimates, February 2005. <https://www.saffm.hq.af.mil/FMB/pb/afpb.html> [17 April 2006]
[33] Peter Hays and others, Spacepower for a New Millennium (New York: McGraw-Hill, 2000), 212.
[34] A quick reference on the proliferation of space assets is provided in Appendix 2 and 3.

In regard to space capabilities, this paradigm shift means that fighting future wars in the 21st century will likely need to account for two new modalities in operations. First, given the expansion of the civil sector, military force enhancement may be more reliant on either purely commercial or dual systems (systems with dual military-civilian use like GPS) for communication and imagery. If space is a viable national commodity, then it needs to be protected, hence DoD will need to accelerate the development of a space control capability. As previously discussed this implies the precursory task of solving the interagency space surveillance problem and the development of a set of global rules of engagement regarding myriad doctrinal and international treaty issues. Akin to the interwar advocacy campaigns for carrier aviation, amphibious operations and strategic bombardment, what is needed here is a single or extremely limited number of champions focused exclusively on space development vice distributed theater commands that by their very nature must remain focused on their operational arena.

Second, any form of space warfare will be warfare surrounded, and to some degree even supported, by noncombatants.[35] While this gives further credence to solving the space surveillance problem, it also implies that space combatants must be intimately familiar with the global impact of not just the specific space system targeted, but also any linkage it may have with other terrestrial systems. An adversarial space system with significant links to neutral or friendly civilian or national systems may be off the targeting list even though a function of the system is to enhance enemy force capability.[36]

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[35] Peter Hays and others, Spacepower for a New Millennium (New York: McGraw-Hill, 2000), 216.

[36] A hypothetical example may be the Russian Global Navigation Satellite System (GLONASS) which continuously transmits coded signals which can be received by users anywhere on the Earth's surface to identify their position and velocity in real time. The system is a counterpart to the United States Global Positioning System and is managed for the Russian Federation Government by the Ministry of Defense of the Russian Federation

While certainly this nodal analysis requirement could (via an OPCON order) be tasked to a theater JFC, the question remains whether it would enhance efficiency over the current system or simply give an already tapped JFC staff further responsibilities and mission obligations far beyond those required of their theater. Given the global impact of space operations it seems unlikely that command of space assets from a theater level is a sound approach. However, it is dangerous to universally assume that all space operations must share a similar command construct, and there may be certain areas in which OPCON of space systems may indeed be exercised at the theater level

Theater Space OPCON

If there is one constant in regards to space it is that it is always changing. New technologies and employment strategies are continually evolving, offering U.S. forces exceptional capabilities in power projection, advanced communications and imagery to name a few. Space doctrine needs to continue to evolve with technological advancements and may reach a point where a theater JFC *is given* OPCON over significant space capabilities. This section will look ahead to highlight three potential areas.

One of the greatest advantages of space is its global presence. While there is no current conventional capability in regard to *force application* from or through space the creation of such a system would grant a theater commander significant combat power in terms of reach and reaction time. From a C^2 perspective a space-based force application capability, given its ability to directly shape a theater's battlespace, should be under the control of a theater JFC to ensure its effects are synergistically woven into the overall campaign plan. The theater COMAFFOR through his/her AOC would be granted control (either OPCON or TACON depending on the type of system employed) of space-based force application systems in the same way as long range strike aircraft.[37] 14th AF would serve as the supporting force provider.

A second developing area is Near-Space (NS).[38] Current experimental NS systems operate between 65,000 and 100,000 feet, far above most, if not all, ground based air threats, and are designed to complement existing terrestrial and space-based C^2 and intelligence systems.[39] Initial DoD testing on high altitude balloons and airships has already begun with promising results. NS systems, depending on the payload aloft, show significant promise in providing high-speed communications, near space satellite imagery coverage and electronic warfare capabilities with an in-theater logistical footprint smaller than current Predator UAV squadrons. Designed with the combatant commander in mind, NS systems would be under theater OPCON to support the joint warfighting team. While not a replacement for space-based assets, NS systems show significant promise as a viable middle-ground between theater and strategic space C^2.

Finally, gaining momentum within DoD's office of Force Transformation is the Operationally Response Space (ORS) concept. Simply put, ORS seeks to develop and employ small microsatellites (systems weighing less than 1000 pounds with launch costs far below traditional satellite systems) not only to augment current space systems, but also to provide theater JFC's a tailored space capability to specifically meet his/her needs. Under ORS, theater commanders would retain OPCON of these diminutive satellites to provide a

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[37] For example: a JFC should be granted TACON over a space based laser system as it flies overhead the theater thus allowing him/her to select its targets; whereas the same JFC should be granted OPCON over NS or ORS systems given their theater centric scope. NS and ORS systems are discussed in later sections.

[38] Near Space" is a term used to describe a transitional altitude regime above that of traditional (air breathing) aircraft but below that where space based vehicles operate. Generally this equates to altitudes between 65,000 to 325,000 feet.

[39] Ed Tomme, Combat Effects from the Near Space Environment (United States Air Force Space Warfare Center briefing, Colorado Springs, Colorado: 2004), 6. Some of the systems being looked at are listed in Appendix 5.

wide range of services such as targeted surveillance of nearby enemy movements over a critical few weeks or months.[40]

Conclusions and Recommendations

Space doctrine must continue its evolutionary path in developing a C^2 organizational structure that effectively integrates space into the joint theater. The current C^2 structure, with USSTRATCOM as the central agency directly supporting theater commanders via the joint 14th AF AOC and theater COMAFFOR staff STO process, provides centralized global control while still being responsive to theater demands. As the lead AOC, 14th AF must continue to provide a common integrated space situational picture to commanders at all echelons.

This paper has striven to demonstrate why OPCON of space forces, except for specific instances, needs to remain within USSTRATCOM. Certainly theater JFCs could be given OPCON with the ability to plan, task and execute inherently global space forces, but not without encompassing serious drawbacks.

First, although some space forces are deployable, and in theory could be assigned to a single JFC, breaking U.S. space forces into "penny packets" is not an efficient way to allocate scarce resources with global potential.[41] Second, resource limitations in terms of both materiel and personnel severely limit the ability to adequately field in each theater an appropriately robust AOC capability to effectively control space based systems, at the same time that DoD is seeking to reduce, not increase, its forward logistical footprint. Third, space units (given theater OPCON) would receive a multitude of requests - sometimes conflicting - from numerous theaters. Who would prioritize the requests? The lack of a centralized

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[40] Andy Pasztor, "Pentagon envisions operations with small satellites," Wall Street Journal, 26 August 2005, A:1.
[41] Brian E. Fredriksson, "Space Power in Joint Operations," Air & Space Power Journal (Summer 2004): 93.

adjudication authority would inevitably result in a less than optimum prioritization process that will strive to meet owning-theater requirements but fail to meet global requirements. Finally, which theater JFC would be responsible for mitigation of potential secondary effects, both military and civilian, inherent within space operations given the symbiotic nature of the system environment? Should a theater JFC devote vital time and energy to determining whether his space-based actions have an impact on an ally's civilian economy so reliant on space systems halfway across the globe?

A singular agency such as USSTRATCOM for space C² is the right organizational answer to integrate space effects into the joint operational theater. The current STO process ensures that space is integrated and synchronized within a JFC's campaign plan while also providing critical theater prioritization and system deconfliction key to any successful space operation. The current space C² construct ensures that a single commander directs space forces at the operational level of war.[42] If America is to exercise its space asymmetric advantage, then it needs to match operational capability with the correct C² organization in order to harness and exploit its advantages.

[42] Ibid, 94

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Appendix 1

Objects in Earth Orbit[43]

What's Up There
As of May 31, 2004

Country/Organization	Satellites	Space Probes	Debris	Total
CIS (Russia/former USSR)	1,349	35	2,618	4,002
US	903	52	2,872	3,827
European Space Agency	35	4	301	340
People's Republic of China	40	0	285	325
Japan	84	7	51	142
India	27	0	104	131
Intl. Telecom Sat. Org.	60	0	0	60
Globalstar	52	0	0	52
France	33	0	16	49
Orbcomm	35	0	0	35
European Telecom Sat. Org.	26	0	0	26
Germany	20	2	1	23
United Kingdom	22	0	1	23
Canada	21	0	1	22
Italy	10	0	3	13
Luxembourg	13	0	0	13
Australia	9	0	2	11
Sea Launch	1	0	10	11
Brazil	10	0	0	10
Sweden	10	0	0	10
Indonesia	9	0	0	9
Intl. Maritime Sat. Org.	9	0	0	9
NATO	8	0	0	8
South Korea	8	0	0	8
Arab Sat. Comm. Org.	7	0	0	7
Argentina	7	0	0	7
Mexico	6	0	0	6
Spain	6	0	0	6
Czech Republic	5	0	0	5
Israel	5	0	0	5
Netherlands	5	0	0	5
Turkey	5	0	0	5
AsiaSat Corp.	4	0	0	4
Intl. Space Station	1	3	0	4
Thailand	4	0	0	4
Denmark	3	0	0	3
Malaysia	3	0	0	3
Norway	3	0	0	3
Saudi Arabia	3	0	0	3
China/Brazil	2	0	0	2
Egypt	2	0	0	2
France/Germany	2	0	0	2
Philippines	2	0	0	2
UAE	2	0	0	2
Algeria	1	0	0	1
Chile	1	0	0	1
EUME	1	0	0	1
Greece	1	0	0	1
NICO	1	0	0	1
Nigeria	1	0	0	1
Pakistan	1	0	0	1
Portugal	1	0	0	1
PRES (China/ESA)	1	0	0	1
Republic of China (Taiwan)	1	0	0	1
Saudi Arabia/France	1	0	0	1
Singapore/Taiwan	1	0	0	1
US/Brazil	1	0	0	1
Total	**2,884**	**103**	**6,265**	**9,252**

[43] Air Force Magazine, 2004 Space Almanac (Washington DC: 2004), 28.

Appendix 2

Payloads in Earth Orbit[44]

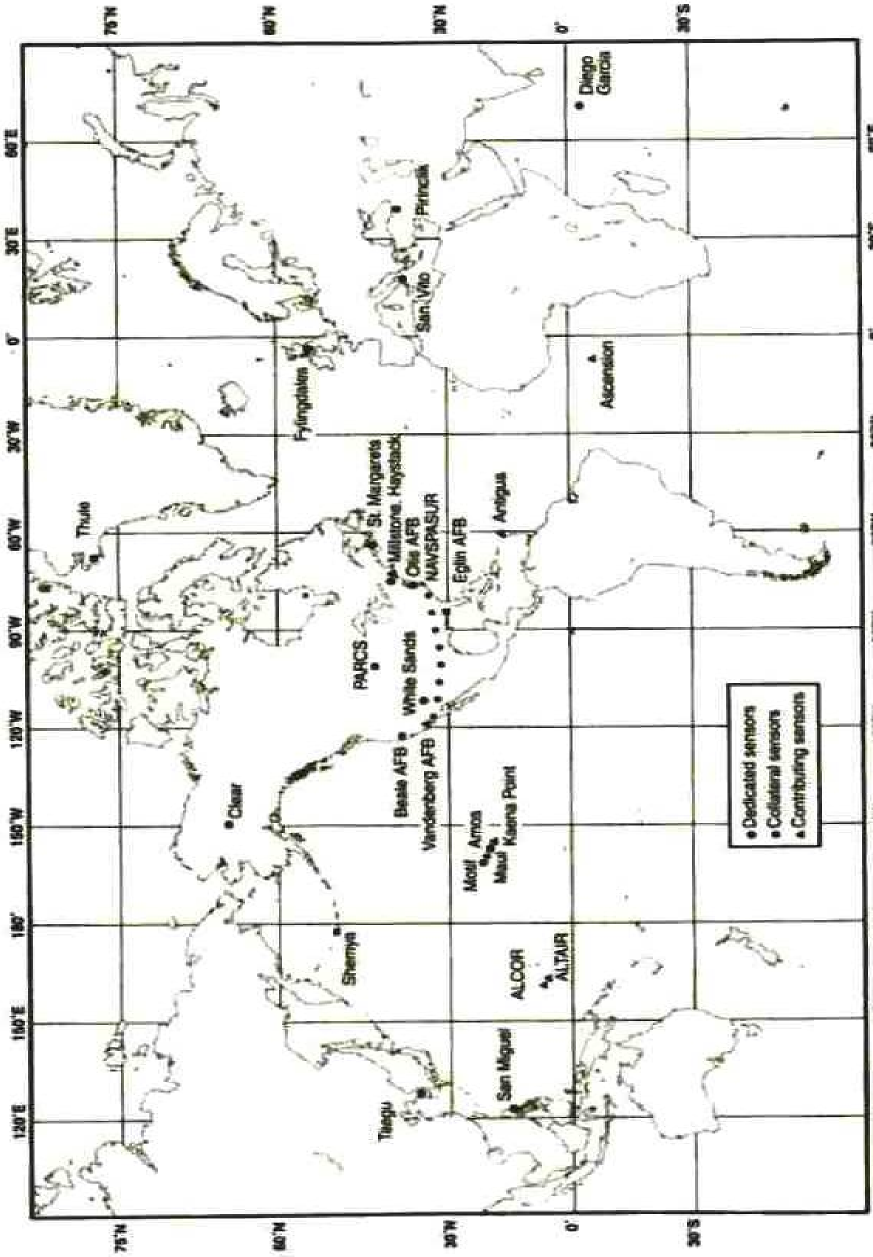
Payloads in Orbit (As of Dec. 31, 2003)	
Launcher/operator	Objects
Russia	1,368
United States	1,054
Japan	88
Intl. Telecommunications Satellite Orgn.	60
France	56
China	46
ESA	43
United Kingdom	32
India	27
Germany	22
Canada	21
Luxembourg	13
Italy	11
Australia	10
Brazil	10
Saudi Arabia	10
Sweden	10
Indonesia	9
NATO	8
South Korea	8
Argentina	7
Mexico	6
Spain	6
Czechoslovakia	5
Israel	5
Netherlands	5
Turkey	5
International Space Station	4
Thailand	4
Denmark	3
Malaysia	3
Norway	3
Egypt	2
France/Germany	2
Philippines	2
United Arab Emirates	2
Algeria	1
Chile	1
Greece	1
Nigeria	1
Pakistan	1
Portugal	1
Singapore	1
South Africa	1
Taiwan	1
Total	**2,979**

[44] Ibid, 49.

Appendix 3

Locations of Ground-Based Space Surveillance Sensors[45]

Figure 2-3. Locations of U.S. Ground-Based Space Surveillance Sensors, Past and Present



Source: Paul B. Stares, *Space and National Security* (Brookings, 1987), p. 206.

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[45] Michael E. O'Hanlon, Neither Star Wars Nor Sanctuary: Constraining the Military Use of Space (Washington DC: Brookings Institute Press, 2004), 52.

Appendix 4

Current Major Military Space Systems[46]

Defense Meteorological Satellite Program
Common name: DMSP
In brief: satellites that collect air, land, sea, and space environmental data to support worldwide strategic and tactical military operations. Operational control transferred to NOAA in 1998; backup operation center at Schriever AFB, Colo., manned by Air Force Reserve Command personnel.
Function: environmental monitoring.
Operator: NPOESS Integrated Program Office.
First launch: May 23, 1962.
Constellation: two (primary).
Orbit altitude: approx 575 miles.

Defense Satellite Communications System III
Common name: DSCS
In brief: nuclear-hardened and jam resistant spacecraft used to transmit high-priority C2 messages to battlefield commanders.
Function: SHF communications.
Operator: AFSPC.
First launch: October 1982.
Constellation: five.
On orbit: 13.
Orbit altitude: 22,000+ miles.

Defense Support Program
Common name: DSP
In brief: early warning spacecraft whose infrared sensors detect heat generated by a missile or booster plume.
Function: strategic and tactical missile launch detection.
Operator: AFSPC.
First launch: November 1970.
Constellation: classified.
On orbit: classified.
Orbit altitude: 22,000+ miles.

Global Broadcast System
Common name: GBS
In brief: wideband communications program, initially using leased commercial satellites, then military systems, to provide digital multimedia data directly to theater warfighters.
Function: high-bandwidth data imagery and video.
Operator: Navy.
First launch: March 1998 (Phase 2 payload on UHF Follow-On).
Constellation: three; commercial augmentation.
On orbit: three.
Orbit altitude: 23,230 miles.

Global Positioning System
Common name: GPS
In brief: constellation of satellites used by military and civilians to determine a precise location and time anywhere on Earth. Block IIR began replacing older GPS spacecraft in mid-1997; first modified Block IIR-M with military (Mcode) on two channels launches in 2004. Next generation Block IIF with extended design life,

[46] Air Force Magazine, 2004 Space Almanac (Washington DC: 2004), 40-43.

faster processors, and new civil signal on third frequency launches in 2006. Generation after next GPS III with advanced anti-jam and higher quality data is slated for initial launch in 2012.
Function: worldwide navigation.
Operator: AFSPC.
First launch: Feb. 22, 1978 (Block I).
Constellation: 28.
Orbit altitude: 12,600 miles.

Milstar Satellite Communications System
Common Name: Milstar
In brief: joint communications satellite that provides secure, jam-resistant communications for essential wartime needs.
Function: EHF communications.
Operator: AFSPC.
First launch: Feb. 7, 1994.
Constellation: five.
On orbit: five.
Orbit altitude: 22,300 miles.

Major Civilian Satellites in US Military Use

Polar Military Satellite Communications
Common name: Polar MILSATCOM
In brief: USAF deployed a modified Navy EHF payload on a host polar orbiting satellite to provide an interim solution to ensure warfighters have protected polar communications capability.
Function: EHF polar communications.
Operator: Navy.
First launch: 1997.
Constellation: three.
On orbit: one.
Orbit altitude: 25,300 miles (apogee).

Wideband Gap-Filler System
Common name: WGS
In brief: high data rate satellite broadcast system (primarily commercial product) meant to bridge the communications gap between current systems and follow on communication satellite systems.
Function: wideband communications and point-to-point service (Ka-band, Ku-band, X-band frequencies).
Operator: AFSPC.
First launch: 2006, planned.
Constellation: three-five.
Orbit altitude: GEO.

Geostationary Operational Environmental Satellite
Common name: GOES
In brief: in equatorial orbit to collect weather data for short-term forecasting.
Function: storm monitoring and tracking, meteorological research.
Operator: NOAA.
First launch: Oct. 16, 1975 (GOES-1).
Constellation: two, with on-orbit spare.
Orbit altitude: 22,300 miles.

Globalstar
Common name: Globalstar
In brief: mobile communications with provision for security controls.
Function: communications.

Operator: Globalstar L.P.
First launch: February 1998.
Constellation: 48.
Orbit altitude: 878 miles.

Ikonos
Common name: Ikonos
In brief: one-meter resolution Earth imaging. Slated for shutdown in 2007.
Function: remote sensing.
Operator: Space Imaging, Inc.
First launch: Sept. 24, 1999.
Constellation: one.
Orbit altitude: 423 miles.

Inmarsat
Common name: Inmarsat
In brief: peacetime mobile communications services, primarily by US Navy.
Function: communications.
Operator: International Maritime Satellite Organization.
First launch: February 1982 (first lease), Oct. 30, 1990 (first launch).
Constellation: nine.
Orbit altitude: 22,300 miles.

Intelsat
Common name: Intelsat
In brief: routine communications and distribution of Armed Forces Radio and TV Services network.
Function: communications.
Operator: International Telecommunications Satellite Organization.
First launch: April 6, 1965 (Early Bird).
Constellation: 20.
Orbit altitude: 22,300 miles.

Iridium
Common name: Iridium
In brief: voice, fax, data transmission.
Function: handheld, mobile communications.
Operator: Iridium L.L.C.
First Launch: May 5, 1997.
Constellation: 66 (six on-orbit spares).
Orbit: 485 miles.

Landsat
Common name: Landsat
In brief: imagery use includes mapping and planning for tactical operations.
Function: remote sensing.
Operator: NASA.
First launch: July 23, 1972.
Constellation: one.
Orbit altitude: 438 miles (polar).

Orbcomm
Common name: Orbcomm
In brief: potential military use under study in Joint Interoperability Warfighter Program.
Function: mobile communications.
Operator: Orbcomm Global L.P.
First launch: April 1995.

Constellation: 35.
Orbit altitude: 500-1,200 miles.
Contractor: Orbital Sciences.

Pan Am Sat
Common name: Pan Am Sat
In brief: routine communications providing telephone, TV, radio, and data.
Function: communications.
Operator: Pan Am Sat.
First launch: 1983.
Constellation: 21.
Orbit altitude: 22,300 miles.

Polar-orbiting Operational Environmental Satellite
Common name: POES
In brief: two advanced third generation environmental satellites (one morning orbit and one afternoon orbit) provide longer-term weather updates for all areas of the world.
Function: extended weather forecasting.
Operator: NOAA (on-orbit); NASA (launch).
First launch: May 13, 1998 (NOAA-15).
Constellation: two.
Orbit altitude: 517 miles.

Quickbird 2
Common name: Quickbird 2
In brief: high-resolution imagery for mapping, military surveillance, weather research, and other uses.
Function: remote sensing.
Operator: Digital Globe.
First launch: Oct. 18, 2001.
Constellation: one.
Orbit altitude: 279 miles.

Satellite Pour l'Observation de la Terre
Common name: SPOT
In brief: terrain images used for mission planning systems, terrain analysis, and mapping.
Function: remote sensing.
Operator: SPOT Image S.A. (France).
First launch: Feb. 22, 1986.
Constellation: three.
Orbit altitude: 509 miles.

Appendix 5

Near Space Systems[47]

AF Space Battlelab is pursuing *Combat SkySat*

- Phase I: Free-floater carrying Army UHF repeater to 100,000 ft
  - Potentially extends handheld communications range to 350 miles

- Phase II of *Combat SkySat is a* sophisticated free-floater with glider recovery carrying high-value ISR sensor
  - Glider flies to runways up to 500 km, 2.5 hrs away
  - *First Alert Cueing* (FAC) sensor detects and locates muzzle flashes and missile launches even through clouds

Army and MDA High Altitude Airship study

- Goal: 500 pound payload, provide 3 kW of power, and remain aloft for 30 days
- ACTD Scheduled to fly FY06
- Possible missions: ABL/GBL relay mirror, homeland security, RC-135 support

Naval Air Warfare Center and National Security Agency funding tests on existing Techsphere

- 65-foot spherical balloon demonstration: ~1000 pounds to ~10,000 ft for several days
- Lower altitude platform in final manned testing
- 200-foot balloon could reach 65,000 ft with similar payload

[47] Information obtained from Ed Tomme, Combat Effects from the Near Space Environment (United States Air Force Space Warfare Center briefing, Colorado Springs, Colorado: 2004)

Appendix 6

Doctrinal Definitions

- Combatant Command (COCOM): *Per joint doctrine*:

  COCOM is the authority of a combatant commander to perform those functions of command over assigned forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction over all aspects of military operations, joint training and logistics necessary to accomplish the missions assigned to the command. COCOM provides full authority to organize and employ commands and forces as the combatant commander considers necessary to accomplish assigned missions.[48]

- Operational Control (OPCON): *Per joint doctrine*:

  OPCOM is the authority to perform those functions of command over subordinate forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction necessary to accomplish the mission. OPCON normally provides full authority to organize commands and forces and employ those forces as the commander in operational control considers necessary to accomplish assigned missions. It does not, in and of itself, include authoritative direction for logistics or matters of administration, discipline, internal organization, or unit training. These elements of COCOM must be specifically delegated by the combatant commander.[49]

- Tactical Control (TACON): *Per joint doctrine*:

  TACON is the command authority over assigned or attached forces or commands, or military capability or forces made available for tasking, that is limited to the detailed and usually local direction and control of movements or maneuvers necessary to accomplish assigned missions or tasks. TACON does not provide organizational authority or authoritative direction for administrative and logistic support; the commander of the parent unit continues to exercise these authorities unless otherwise specified in the establishing directive.[50]

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[48] Joint Chiefs of Staff, Joint Doctrine Encyclopedia, (Washington DC: 16 July 1997), 144
[49] Ibid, 563.
[50] Ibid, 677.